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ARMY WWMCCS INFORMATION SYSTEM (AWIS):  
A STRATEGIC COMMAND AND CONTROL SYSTEM

BY

COLONEL M. I. HOSAKA

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World War Military Command and Control System (WWMCCS)

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means to more effectively mobilize, deploy, employ, and sustain a force. It will also analyze the status of the present AWIS program in light of the recent transfer of the Joint WIS program from the Air Force to the Defense Communications Agency (DCA). Finally, this study will make recommendations on suggested improvements in the development and acquisition of the program's hardware and software products.

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USAWC MILITARY STUDIES PROGRAM PAPER

ARMY WWMCCS INFORMATION SYSTEM (AWIS): A STRATEGIC  
COMMAND AND CONTROL SYSTEM

AN INDIVIDUAL STUDY PROJECT

by

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U.S. Army War College  
Carlisle Barracks, Pennsylvania 17013  
23 March 1990

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# ABSTRACT

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ARMY WWMCCS INFORMATION SYSTEM (AWIS):  
A STRATEGIC COMMAND AND CONTROL SYSTEM

CHAPTER I

INTRODUCTION

A well known saying states that: "Congress makes an individual a General; Communications makes that individual a Commanding General." I submit that a present-day version of this saying would state that it is "information" that makes an individual a Commanding General. The Army World Wide Military Command and Control System Information System (AWIS) will provide this modern information system capability in the near future.

The World Wide Military Command and Control System (WWMCCS) technically consists of many loosely connected systems with the mission of providing instantaneous, accurate data and a decision support system to satisfy three primary missions: day-to-day command and control operations; crisis management; and critical command and control orders that must reach the forces. Figure 1 diagrams the various elements of the WWMCCS in block format with the Data Collection and Processing element expanded.<sup>1</sup>

One of the WWMCCS systems is the WWMCCS Automatic Data Processing (ADP) program with its backbone of numerous large-scale Honeywell DPS8 host computers located at all major Department of Defense Command Centers throughout the world. Figure 2 illustrates WWMCCS relationships with other non-WWMCCS systems. Thousands of work stations and terminals are used to build, update, and manipulate the information (data bases) stored



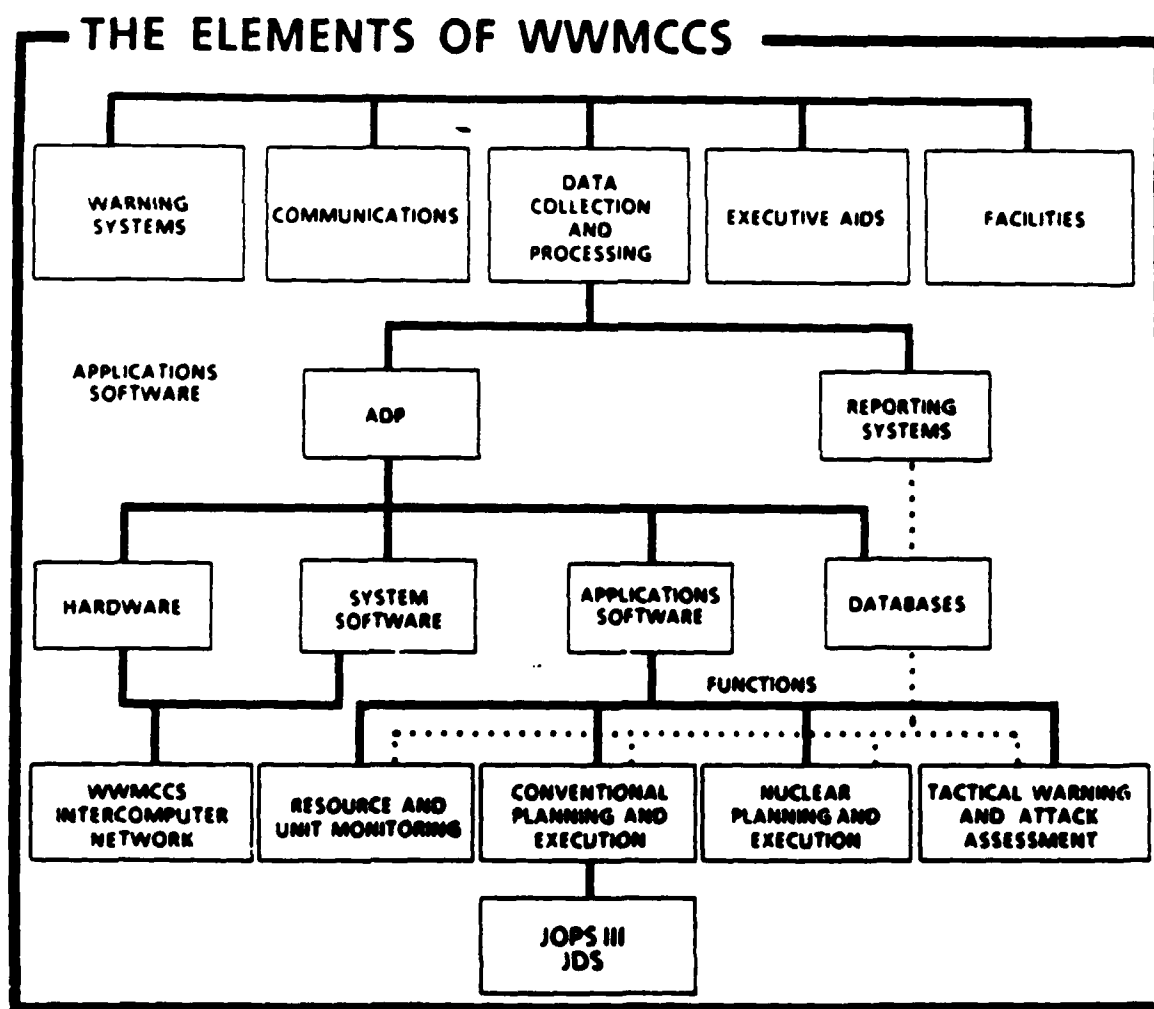


FIGURE 1

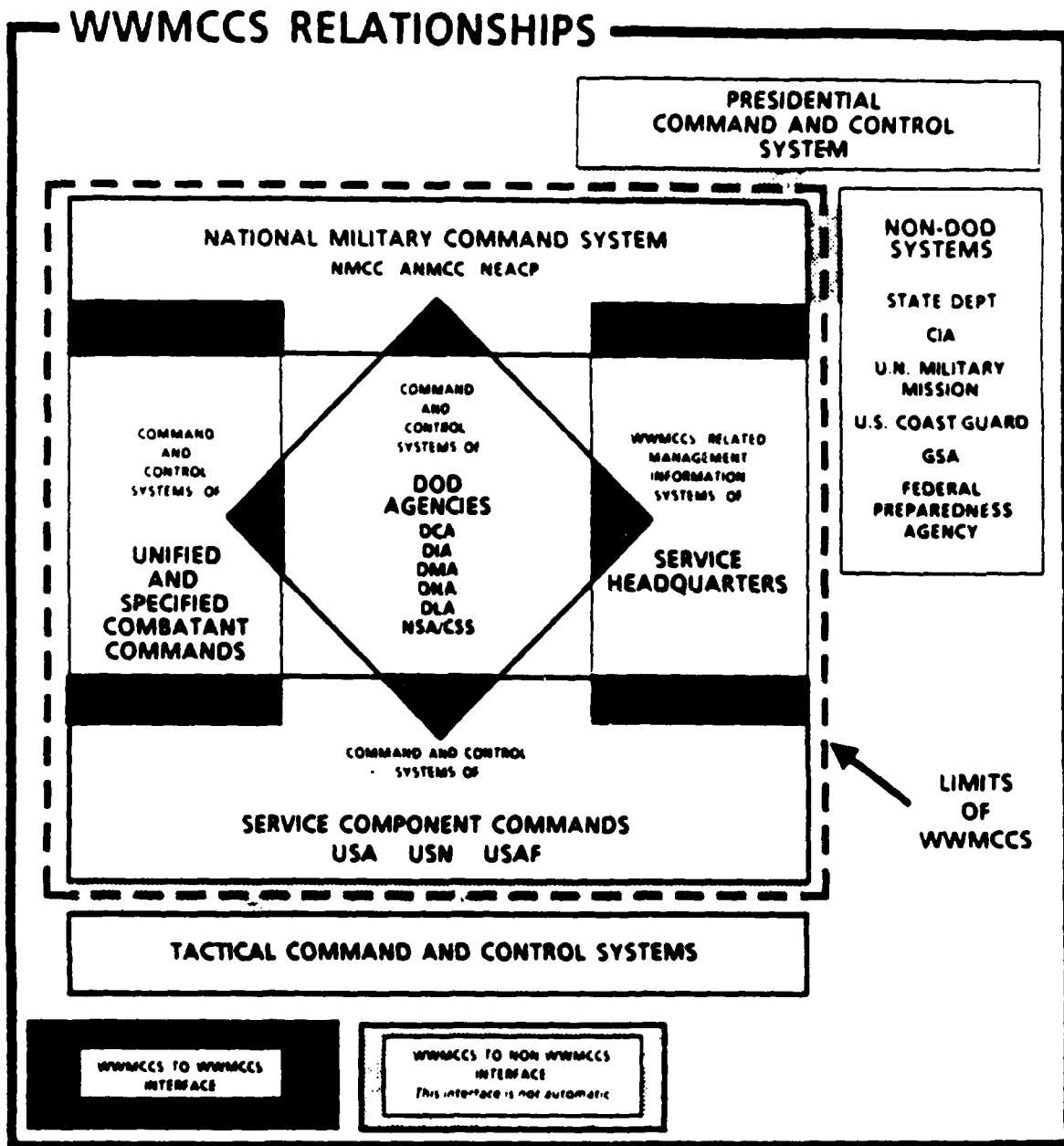


FIGURE 2

in the host computers.<sup>2</sup> All the host computers are interconnected by a large, robust communications network call the WWMCCS Intercomputer Network (WIN). Figure 3 illustrates the capabilities of WIN.<sup>3</sup> The WWMCCS ADP program focuses on the development and execution of war plans; it emphasizes mobilization, deployment, employment and sustainment of the force.

The WWMCCS Information System (WIS) was mandated by Congress in the early 1980s to modernize the WWMCCS ADP program and to correct many, very serious deficiencies in the DoD's primary strategic, go-to-war system. The Air Force was named the executive agent to modernize the Joint WIS program, and each service set up a project office to modernize its own system (AFWIS, NWIS and AWIS).

This study will focus on the Army's AWIS program and will trace AWIS from the original inception in 1984 to the present. In a time of shrinking resources, it is very probable that many Army troops will be returned to CONUS and the Army will purchase fewer and fewer weapons systems. Major changes to the Army's mission--from providing large, extremely heavy forces to deploying extremely fast, light focused specialized troops--will increase the priority and criticality for building and modernizing the Army's Strategic Command and Control System.

This study will explore the AWIS program as a force multiplier and a means to more effectively mobilize, deploy, employ and sustain a force. It will analyze the status of the present AWIS program in light of the recent reestablishment of

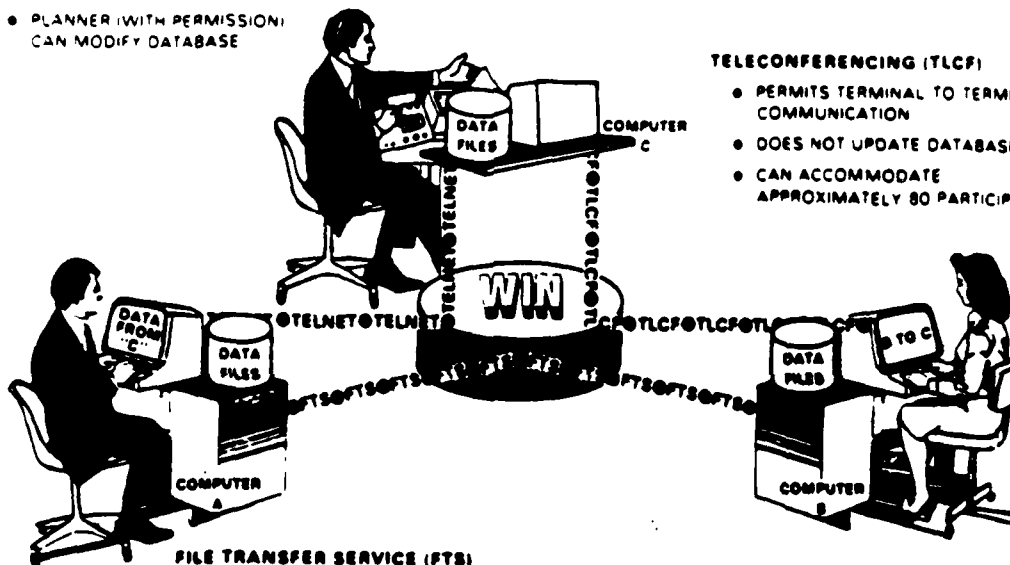
## COMMUNICATING VIA WIN

### TELECOMMUNICATION NETWORK (TELNET)

- PLANNER CAN ACCESS COMPUTER AND PROGRAMS AT OTHER LOCATIONS
- PLANNER CAN REVIEW AND PRODUCE PRINTOUTS OF DATABASE
- PLANNER (WITH PERMISSION) CAN MODIFY DATABASE

### TELECONFERENCING (TLCF)

- PERMITS TERMINAL TO TERMINAL COMMUNICATION
- DOES NOT UPDATE DATABASE
- CAN ACCOMMODATE APPROXIMATELY 80 PARTICIPANTS



### FILE TRANSFER SERVICE (FTS)

- PERMITS TRANSFER OF LARGE AMOUNTS OF DATA
- TRANSMISSION IS RAPID ACCURATE AND SECURE
- WIN MAIL TO SEND AND RECEIVE MESSAGES

FIGURE 3

the Joint WIS program under the Defense Communication Agency (DCA). Finally, the study will make recommendations on suggested improvements in the development and acquisition of program software and hardware products.

### MISSION

The AWIS Project Management Office (PMO) was chartered by the Secretary of the Army and established in 1984. The Project Manager (PM) for AWIS is the Army component of a joint modernization effort to provide operational planning and execution capabilities for the National Command Authority (NCA) at Echelons Above Corps (EAC). The program identifies information requirements, develops an integrated architecture, and implements a system to support the mobilization, deployment, employment, and sustainment of conventional forces during crisis and war. It will provide information to WIS and meet unique Army requirements as well.<sup>4</sup>

The PM AWIS is responsible for planning and implementing the portion of the WWMCCS Information System (WIS) supporting the Army sponsored Unified and Specified Commands, the Army Components, the Transportation Operation Agencies (TOA), and Headquarters, Department of the Army. The PM is also responsible for the planning, development, and fielding of the Command and Control (C2) Army Theater Architecture, which provides information exchange from the tactical C2 systems through the

theater to the strategic C2 systems supporting the Army headquarters at EAC.

On 1 July 1986, AWIS and the Command and Control Systems (CCS) project were merged to become AWIS/CCS with all responsibilities of the former PM CCS incorporated into AWIS. The CCS project consists of a group of command and control programs that supports the battlefield commander at EAC. This merger was designed to provide for total integration of the ADP and C2 functions and to foster standardization and interoperability among theater level commands. This expanded mission included:

- Army implementor of Joint Operation Planning and Execution System (JOPES).

- Identifications of C2 transportable requirements.

- Fielding of two transportable C2 systems for Europe.

- Implementing and fielding of the Logistics Network (LOGNET).

- Fielding of a secret level WWMCCS capability.5

#### WIS PROGRAM DESCRIPTION

In the early 1970s, the DoD procured ADP equipment to support decision making at many of its commands and to support the WWMCCS. This equipment became obsolete due to age and outmoded technology. In the last few years, the state of the art has changed significantly, since computer and communications

equipment have become substantially smaller, more reliable, and less expensive.

Plans and a architecture for WWMCCS modernization were developed and documented in reports to Congress in 1980, 1981, and 1982. The General Accounting Office (GAO) also conducted investigations into needed improvements in the system. Their concerns were included in a 1982 report to Congress and are listed in Figure 4.

In November 1981, the Chief of Staff of the Air Force was designated as the Executive Agent for the WIS modernization program; in January 1982, he appointed a WIS PM to be responsible for continuing WIS development. The Joint Program Manager (JPM) assigned top priority to systems that performed standard (joint missions) command and control functions. Systems that performed service or command unique functions would be the responsibility of the individual service and would be developed in close coordination with the joint WIS community. Figure 5 depicts the incremental development concept.<sup>6</sup>

WIS consists of the software, hardware, integrated support and connectivity necessary to facilitate planning, directing, coordinating, monitoring, and controlling conventional military operations. The scope of the WIS program is to:

- Modernize WWMCCS standard ADP and directly related telecommunications.

- Support the modernization of the C2 systems for conventional operations, both joint and service, and command unique portions.

## **EXISTING WWMCCS DEFICIENCIES**

- **LIMITED PEACETIME PLANNING AND WARTIME EXECUTION LINKAGE**
- **INADEQUATE SUPPORT FOR MOBILIZATION, DEPLOYMENT, EMPLOYMENT AND SUSTAINMENT**
- **INADEQUATE SUPPORT FOR NO-PLAN/MULTI-PLAN SITUATIONS**
- **INADEQUATE FORCE STATUS MONITORING CAPABILITY**
- **ANTIQUATED, INEFFICIENT DATA MANAGEMENT**
- **INCREASING O&M COSTS**
- **INADEQUATE MESSAGE PROCESSING CAPABILITY**

**FIGURE 4**



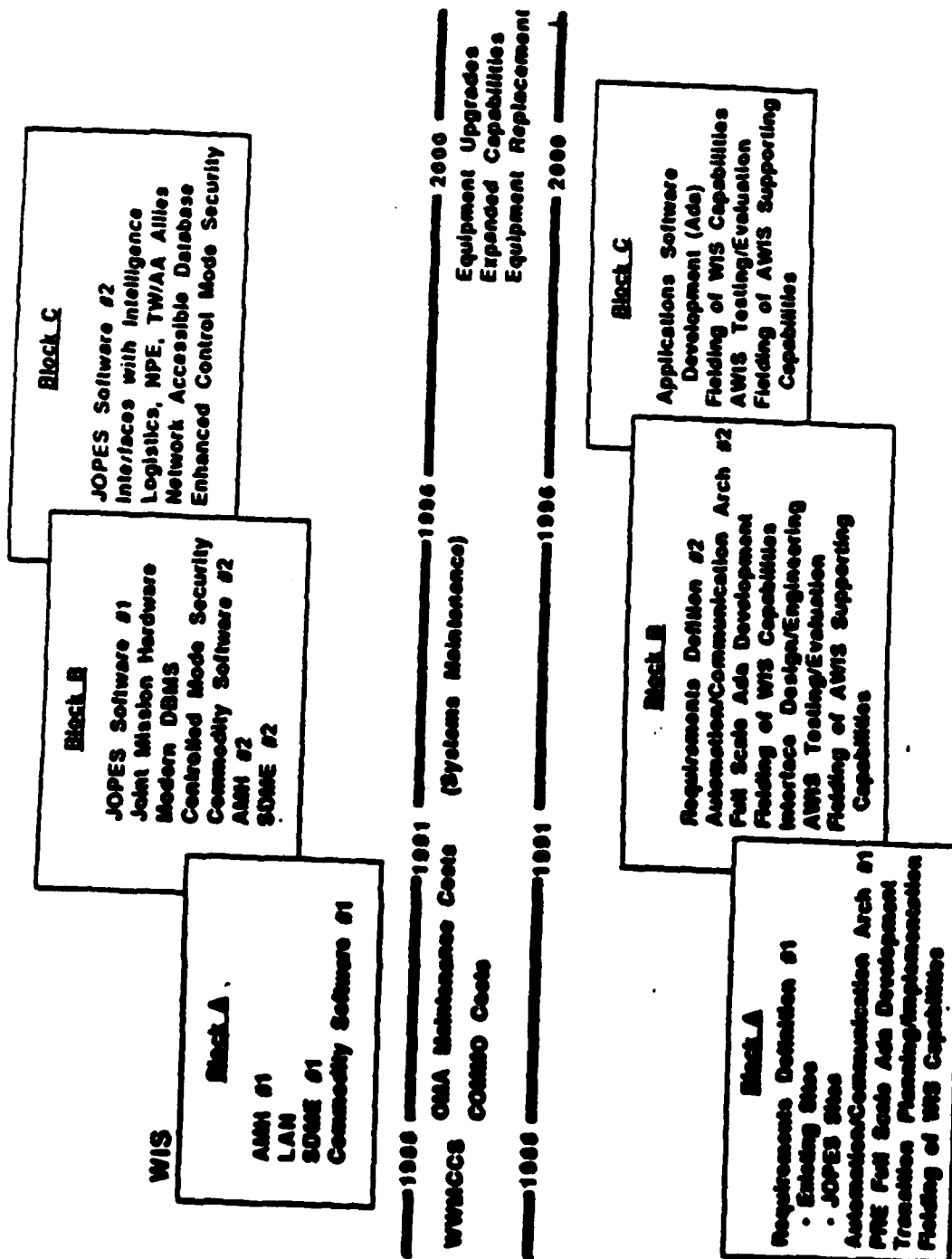


FIGURE 5  
WIS/WWMACCS/AWIS DEVELOPMENT

-Support the tasks required during mobilization, deployment, employment, and sustainment activities to include monitoring, planning, and execution for peacetime, crisis, and wartime operations.<sup>7</sup>

#### AWIS/CCS PROGRAM OBJECTIVES

The authority for requirements development and contract efforts are set forth in the following two documents:

"(The) detailed information needs of WWMCCS nodes must be addressed...The services must take the lead and ...collect the necessary requirements of WWMCCS nodes."

Assistant Secretary of Defense  
2 April 1981

"The services (will) conduct (requirements) interviews at the operations centers and headquarters of their respective services, Unified and Specified Commands, Component Commands and TOAs."

Office of the Joint Chiefs of Staff  
3 June 1981

When tasked in 1983, the AWIS mission was limited to the modernization of the eight WWMCCS sites under the operational control of the Department of the Army. The modernization effort, as mandated by Congress, was to address hardware, software, communications, procedures, policy and processes. The PM AWIS was further responsible to insure that an orderly and effective transition was effected. This transition was to be accomplished without any degradation to the capabilities of the existing Army's WWMCCS ADP system.

Over time, additional sites, projects, and products have been tasked to the PM; together, they form a program of modernization for C2 at Theater (EAC) and Army Major Commands as shown in Figure 6. The center of the diagram cites products being developed that are used not only to support the Army WWMCCS improvement mission but also to support command centers, EAC programs and other Army command unique requirements.<sup>8</sup>

#### AWIS/CCS SYSTEMS ARCHITECTURE

The AWIS will be a substantially modernized, improved, and expanded version of the support capabilities provided by existing WWMCCS ADP and related telecommunications components. The modernization will involve a major redesign and replacement of existing WWMCCS components, over time, in an incremental and evolutionary strategy that will reduce manpower and maintenance requirements, make it less expensive to maintain and more responsive and reliable to user needs. AWIS has an established architectural design that includes implementation of hardware, software, communications interfaces, and data bases to support joint mission systems. Specifically, the AWIS architecture contains:

- A Local Area Network (LAN) for local connectivity.
- A mechanism and protocols for linking in the WIN and Digital Data Network (DDN).
- A Common User Subsystem (CUS) for Automated Message

# AWIS/CCS TWO PARTS BUT ONE PURPOSE

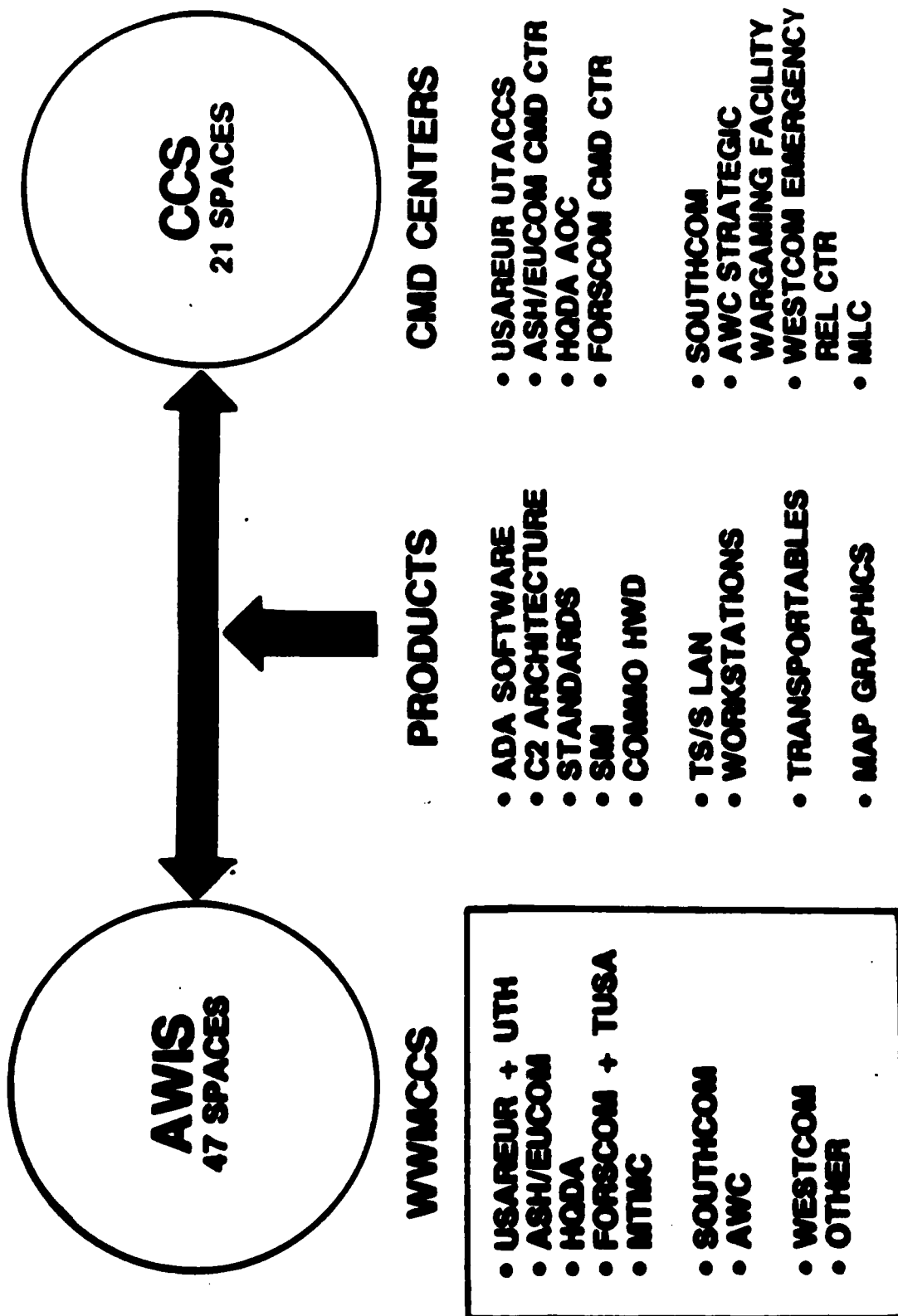


FIGURE 6

Handling (AMHS), electronic mail, user terminal hardware and software support, and data base services.

-Joint mission software design, development, and implementation.

-Joint mission hardware and ADP security.9

#### ENDNOTES

1. Armed Forces Staff College, AFSC Pub 1, p. 118.
2. Ibid., p. 119.
3. Ibid., p. 120.
4. Army WWMCCS Information System/Command and Control Systems, Program Management Plan (PMP), p. 1-1.
5. Ibid., p. 1-2.
6. Ibid., p. 3-2.
7. Ibid., p. 3-3.
8. Ibid., p. 3-5.
9. Ibid., p. 5-8.

## CHAPTER II

### AWIS HARDWARE DEVELOPMENT

The Joint WIS program had been inefficiently managed in the past years. Consequently, it has been transferred from the Air Force to the Defense Communication Agency (DCA). Unfortunately, the Army's program to modernize the service portion of WWMCCS has suffered by association. The joint program is needed to provide capstone JCS level hardware and software. Even so, the AWIS program will now be managed by a new authority in order to continue to provide enhanced C2 capability to the Army in support of its strategic and EAC missions.<sup>1</sup>

### BACKGROUND

The joint program was designed to provide the joint hardware depicted in Figure 7. The AWIS program was to be responsible for all additional hardware that was not provided by the joint program and to develop and plan for the integration and transition of the service system into the new WIS/AWIS world.

The evolutionary WIS joint program acquisition strategy would establish a core capability and, through iterative blocks, continually upgrade that core. The recent decoupling of the joint program's initial block A upgrade necessitated that the AWIS program develop its own hardware fielding plan, shown in Figure 8.

# WWMCCS ARCHITECTURE (TOP SECRET HIGH SYSTEM)

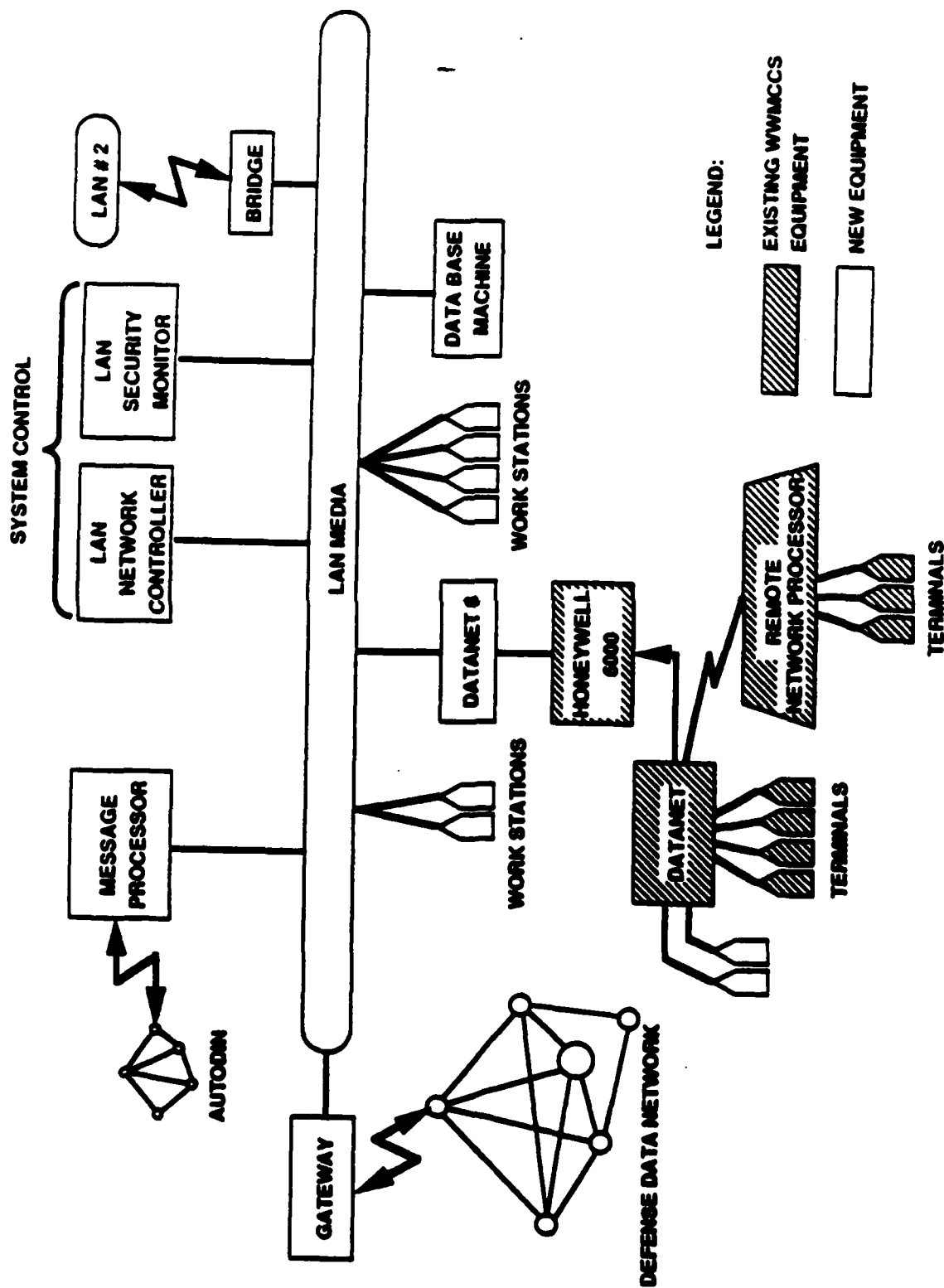


FIGURE 7

# AWIS HARDWARE FIELDING PLAN

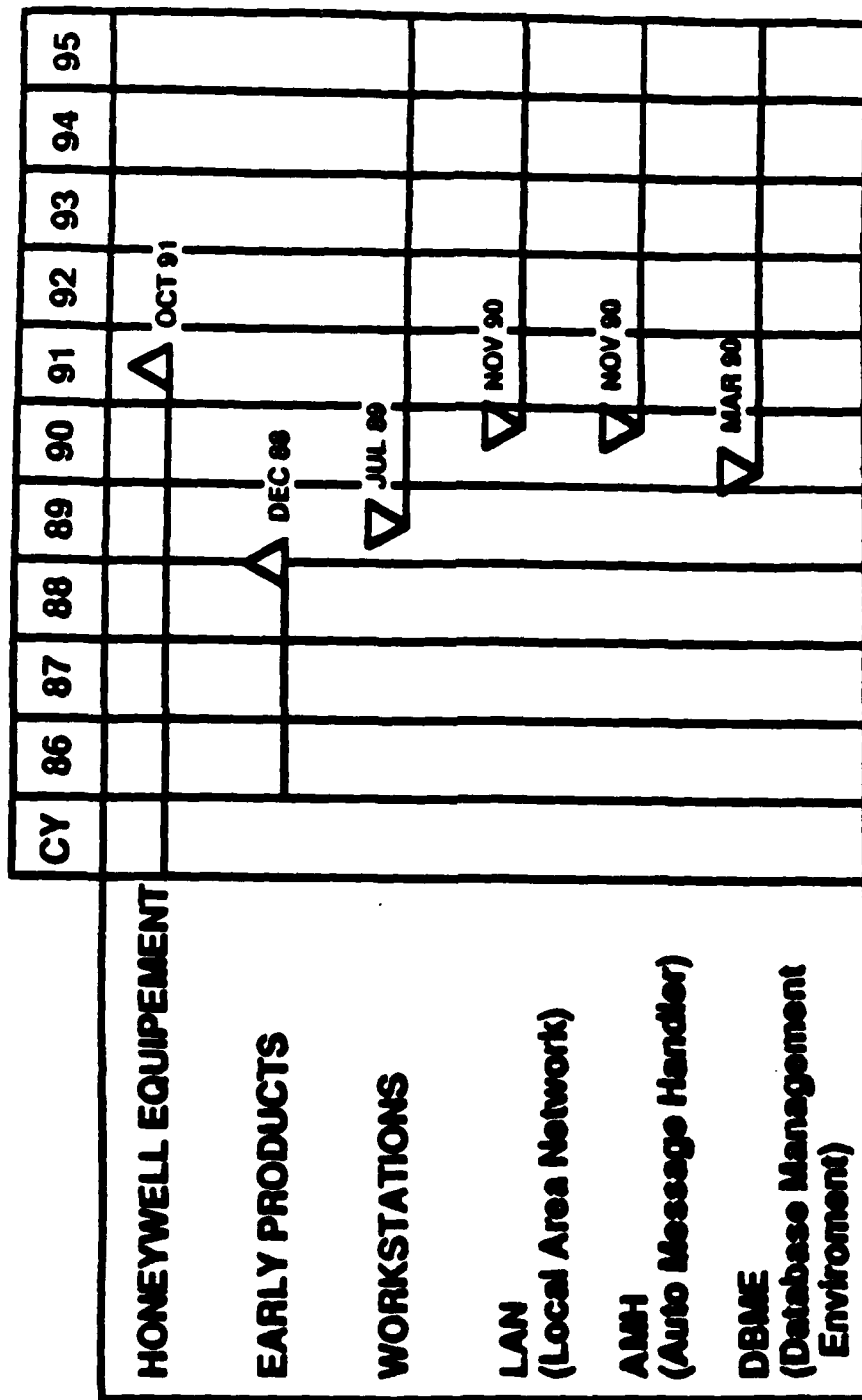


FIGURE 8



### Honeywell Equipment

Equipment will continue to be fielded from the existing WWMCCS Honeywell contract. The contract includes the upgrade of host processors currently at the AWIS sites, memory upgrades required for GCOS8, DATANET8 for LAN connectivity, and replacement equipment to reduce the footprint at all sites. This contract expires in 1991 but will most likely be extended again.

### Early Products Workstations

The early products workstations contract with IBM expired in December 1988. A workstations contract was awarded in November 1988, and tempest workstations were fielded beginning in July 1989.

### Local Area Network (LAN)

GTE is responsible for the development and installation of the AWIS Local Area Network (LAN). The installation of a LAN at an Army operational test site is scheduled to begin in November 1990.

### Automatic Message Handling System (AMHS)

The Automatic Message Handling System (AMHS) is presently under development and scheduled to be installed in November 1990. Only the Army Operations Center (AOC) has an AMHS capability, but their message handler is considered unsatisfactory. One of its major shortfalls is the delay in message delivery during exercises. Often as many as 2,000 messages are received each

day, leading to delayed delivery and mishandling problems. The improved AMHS will provide the capability to receive messages from AUTODIN and have them routed to an action officer at his workstation based upon keyword profiling. This reduces risk and significantly reduces the time to receive and transmit message-sensitive information.<sup>2</sup> Figure 9 itemizes AMHS capabilities.

### RECOMMENDATIONS

The US Army War College (USAWC) Strategic Wargaming Facility (SWF) is presently in the initial planning stage. The purpose of this facility is to provide a conference center to support the Army Chief of Staff and CinCs for symposia, meetings, and wargaming sessions in an academic environment.<sup>3</sup> The mission of this facility is illustrated in Figure 10. The SWF would be the ideal Army operational test site for the development and installation of both the top secret LAN and the AMHS. This multifaceted facility would provide an extended capability for AWIS software products to be run on WWMCCS equipment and to test and use techniques developed for command center projects. The combination would create a synergistic effect for all these efforts.<sup>4</sup>

### ENDNOTES

1. Interview with James White, COL, Project Management Office AWIS, Fort Belvoir, Virginia, 7 October 1989.

2. Interview with James Bray, Project Management Office AWIS, Fort Belvoir, Virginia, 10 November 1989.

## **AU AUTOMATED MESSAGE HANDLING (AMH MROC)**

- Desk to desk message communications
  - Full text message scan
  - Delivery based on user defined profiles message section collation
  - Electronic coordination & release of messages
- Enable staff to handle large volume of messages (up to 2,000 received per day)
  - Message summary
  - Message query capability
  - User data base
- Significantly reduce time to receive and transmit messages (minutes vs hours)
  - 30 day on-line
  - 6 month archive
  - Assistance in draft message preparation
- Reduce risk of action officer not receiving message

FIGURE 9

**US ARMY WAR COLLEGE (AWC)  
STRATEGIC WARGAMING FACILITY (SWF)**

**MISSION**

**A SPECIAL PURPOSE, CONTROLLED ACCESS FACILITY PROVIDING  
THE USAWC THE CAPABILITY TO:**

- SUPPORT NATIONAL AND ARMY LEVEL OPERATIONAL MISSIONS  
AND WARFIGHTING REQUIREMENTS**
- CONDUCT STRATEGIC LEVEL WARGAMING AND SIMULATIONS,  
SYMPOSIA, CINC CONFERENCES AND OTHER SIMILAR  
FUNCTIONS**
- RESPOND TO OTHER NEEDS OF THE CHIEF OF STAFF ARMY**

**FIGURE 10**

3. Interview with Ernest A. Levassuer, COL, Project Management Office SWF, Carlisle Barracks, Pennsylvania, 28 October 1989.

4 Interview with Robert Brynildsen, Project Management Office AWIS, Fort Monmouth, New Jersey, 12 January 1990.

## CHAPTER III

### AWIS SOFTWARE DEVELOPMENT

AWIS software products are critical to the success of the Army's WWMCCS ADP modernization effort. The foundations upon which AWIS's software development were originally based have radically changed. Restructuring of the joint program along with repeated slips in key deliveries of all joint products have together necessitated a review of AWIS's software development strategies.

#### BACKGROUND

The upper portion of Figure 11 illustrates the current WWMCCS environment, which is based on 1960s technology. Standards are nonexistent and multiple computer languages create a barrier for the user in obtaining time sensitive information. To obtain needed information, application programmers are required to write routines often requiring extensive resources and weeks to months of delay. Currently, over 12 million lines of code, with duplicative functionality, are installed at Army sites. Software maintenance costs have become intolerably expensive.

The lower portion of Figure 11 depicts the AWIS objective system. AWIS will accommodate the user's requirement for a highly interactive, user-friendly, on-line query and retrieval capability. The program will produce a sophisticated user

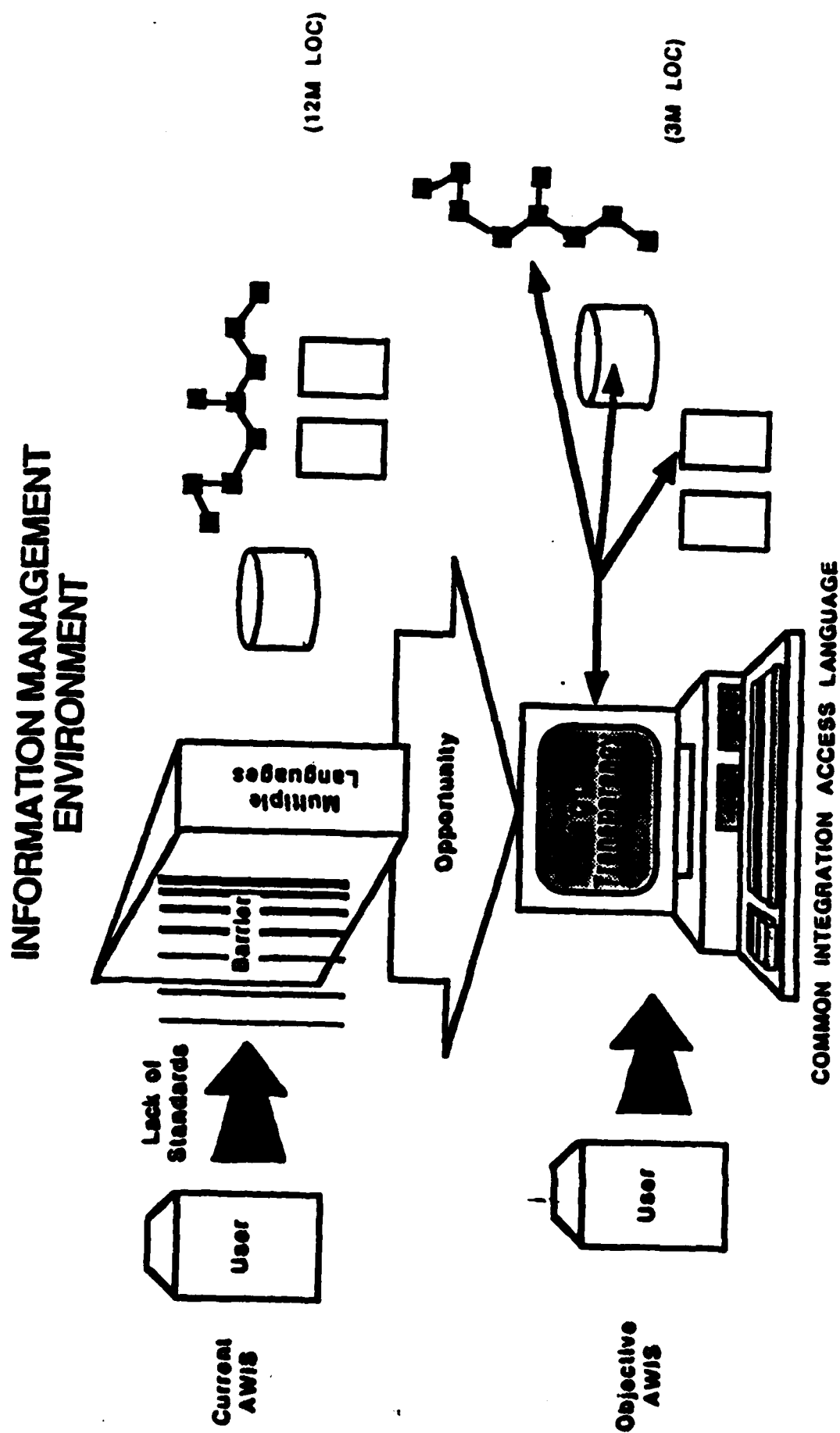


FIGURE 11

accessible data base that has a Standard Query Language (SQL) and a data dictionary. The existing 12 million lines of code will be replaced with some 3 million lines of Ada. In addition to the critically needed increased functionality, the life cycle maintenance savings are expected to total \$.5 billion.<sup>1</sup>

#### SOFTWARE CONTRACT

The AWIS Software Development (ASD) contract was awarded in January 1987 to the TRW Corporation. The contract is currently in Option Year Two, with an estimated completion date of March 1993. The timeline of the contract is shown in Figure 12.

The contract should provide a Full Scale Development (FSD) effort for AWIS, which includes defining, designing, developing, documenting, and deploying into full operation a core of functional software products. The software products will support Army WWMCCS, command centers, and echelons above corps C2 software requirements. The FSD effort will also meet the requirement to flow information to and from Army theater tactical, sustaining base, and JCS systems. In addition, the contract calls for acquiring a production quality Ada Program Support Environment (APSE) along with the necessary automated tools to provide the functionality needed for a large scale development. Figure 13 illustrates the proposed APSE.<sup>2</sup>



# ASD CONTRACT TIMELINE

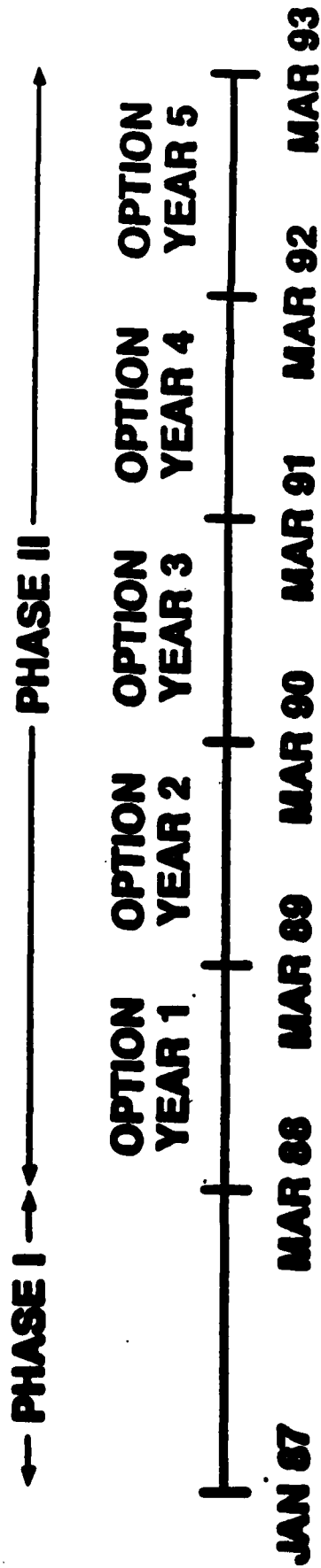


FIGURE 12

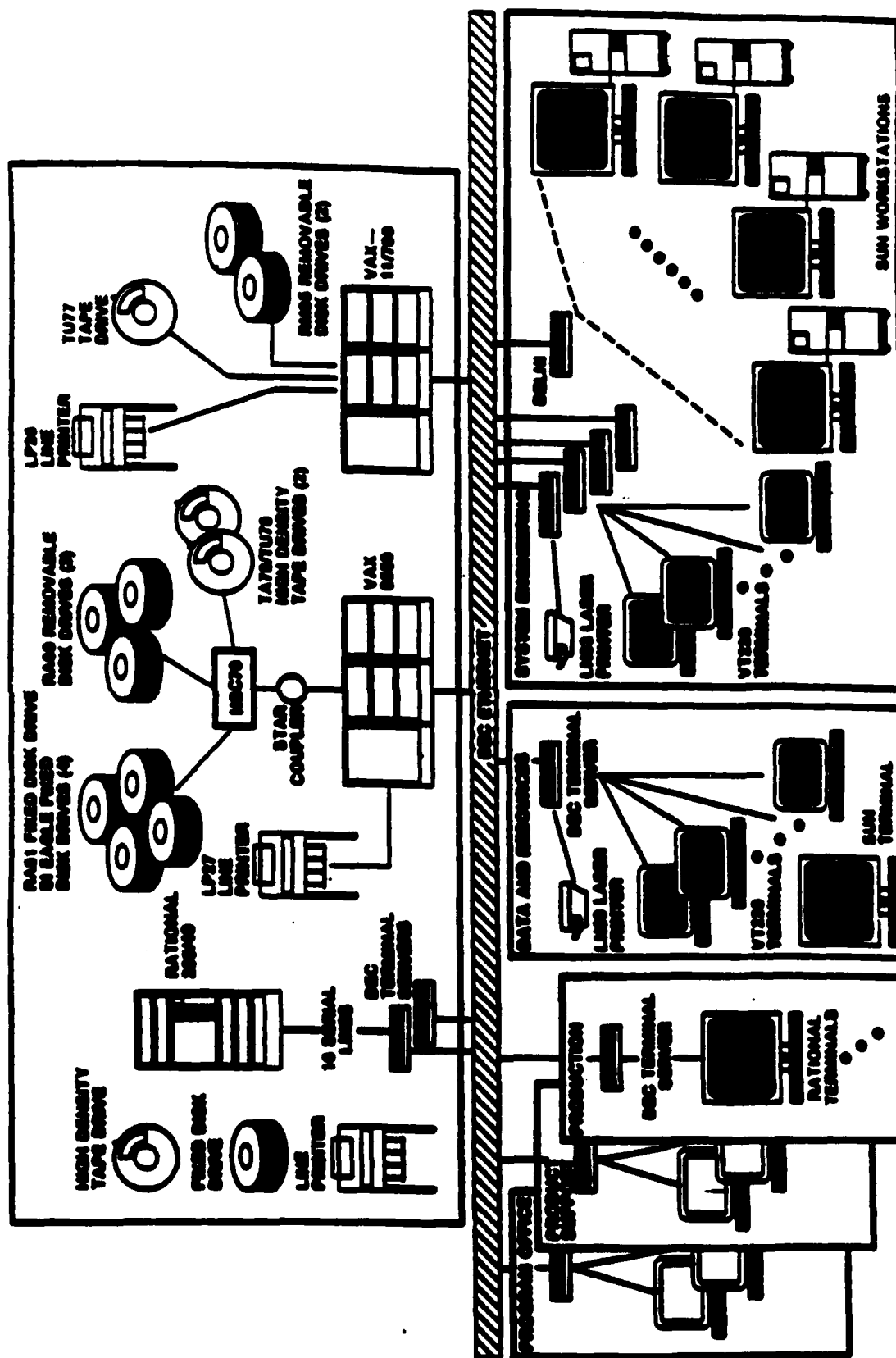


FIGURE 13 Ada Program Support Environment (APSE)

## PRODUCT LINES

The ASD Phase I task was based on an extensive analysis of C2 functions that apply across all commands. This effort dramatically decreased the amount of software needed; it as well established a requirement for the software product lines listed in Figure 14.

To develop these software product lines, a prototyping approach is being used to reduce risk and to incrementally validate use requirements. The goal is for early delivery of operational prototypes; they will be released in segments of 100K lines of code so that improved capability can be fielded quickly. The overall AWIS software Master Plan is shown in Figure 15.

The first release of the Movement Control and Readiness Reporting (MCRR) product line was fielded to USAREUR for use in the WINTEX '89 FTX. The first release of Mobilization and Deployment (MOB/DE) product line was fielded to FORSCOM in September 1989. Likewise, the Unit Status, Logistics, Personnel, C3 Management, and Operations product lines are now under development with releases scheduled to the field in 1990.

The importance of the AWIS program effort to the senior leadership of the Army can be substantiated in a letter sent to the AWIS Project Management Office (PMO) by LTG Ross. After having been briefed on the Logistics products line, LTG Ross wrote,

...the development of this new capability is of unique importance to the Army. For the first time, the critical Joint Operational Planning and Execution System (JOPEs) logistics command and control functions

# SOFTWARE PRODUCT LINES

- |                          |                         |
|--------------------------|-------------------------|
| ● Civil Engineering      | ● Mobilization          |
| ● Deployment             | ● Operations            |
| ● Exercise               | ● Provost Marshal       |
| ● Force Planning         | ● Personnel             |
| ● Host Nation Support    | ● Reconnaissance        |
| ● Information Management | ● Training              |
| ● Intelligence           | ● Transportation        |
| ● Logistics              | ● Unit Status Reporting |
| ● Medical                | ● Weather               |

FIGURE 14

# AWIS SOFTWARE MASTER PLAN

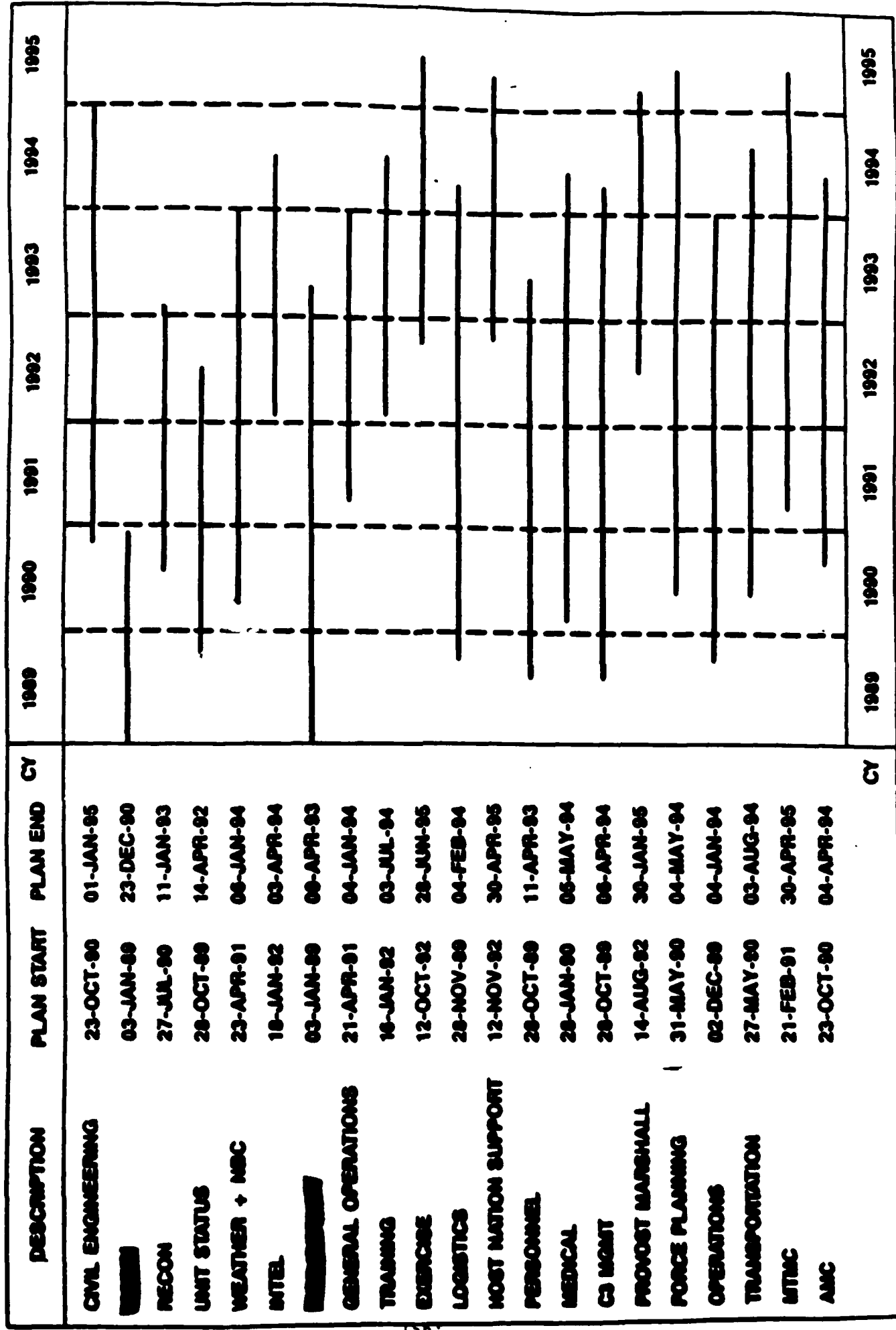


FIGURE 15

of HQDA and the Army major commands will be performed as part of an Army standard system.

LTG Ross  
DCSLOG  
26 May 1989

The AWIS software development effort is a \$100 million+ Ada-based program that is modernizing strategic Army C2 software. While current efforts are site-oriented, it is planned that subsequent software modules will be developed and fielded on a functional basis usable by multiple Army WWMCCS sites.

The original program was structured with very tight schedule and programmatic linkages to capabilities and architectures that were to have been provided to AWIS by the joint program. With the recent transfer of the joint program, those linkages are now essentially "broken". This has made the AWIS software program especially challenging. In addition to the breakage of joint program linkages cited above, other significant challenges remain:

- The necessity for rapid software development in the absence of total system engineering.

- The difficulty of incrementally implementing a modern Relational Database Management Environment (RDBME) while AWIS sites continue to use various obsolete DBMSs.

- The understated complexity of fielding and transition.

- The continuing immaturity of WWMCCS-qualified Honeywell/Bull Ada products and tools for large-scale data base applications.

-The need to continue to operate in an ill-defined, evolving, and politically-sensitive joint software environment.<sup>3</sup>

### RECOMMENDATIONS

Recommend the following three mutually-supportive, top-level goals form the basis for all future AWIS software development efforts:

- Goal #1: Sustain the program's momentum.
- Goal #2: Build robust, reusable systems.
- Goal #3: Emphasize fielding and transition.

Figure 16 illustrates an overview of this approach.

#### Goal #1: Sustain the Program's Momentum

The AWIS program has historically been successful. The PMO has had many successes in putting hardware on the ground, has several innovative programs underway, and--unlike the joint program--has an extensive functional requirements baseline. However, any lengthy delays in software deliveries will quickly dampen enthusiasm from the field for the project. Long delays inherent in the traditional waterfall model approach to software development, illustrated in Figure 17, will lessen support even more.<sup>4</sup>

The challenge is to maintain the momentum of the program and garner user support while continuing to do long-term system development on AWIS software product lines. Careful management of prototyping activities will produce great payoffs in fostering

**SPIRAL MODEL**

**#1 SUSTAIN**

**GOALS**

- SPIRAL MODEL
- PROTOTYPING
- DEMONSTRATION
- OPERATIONAL

**#2 BUILD**

**DEVELOPMENT**

- AWIS SOFTWARE
- INCREMENTAL DEVELOPMENT PLAN
- SOFTWARE DESIGN
- DATA BASE DESIGN

**#3 FIELD**

**DEVELOPMENT**

- SITE-SPECIFIC
- SYSTEM-WIDE

17a



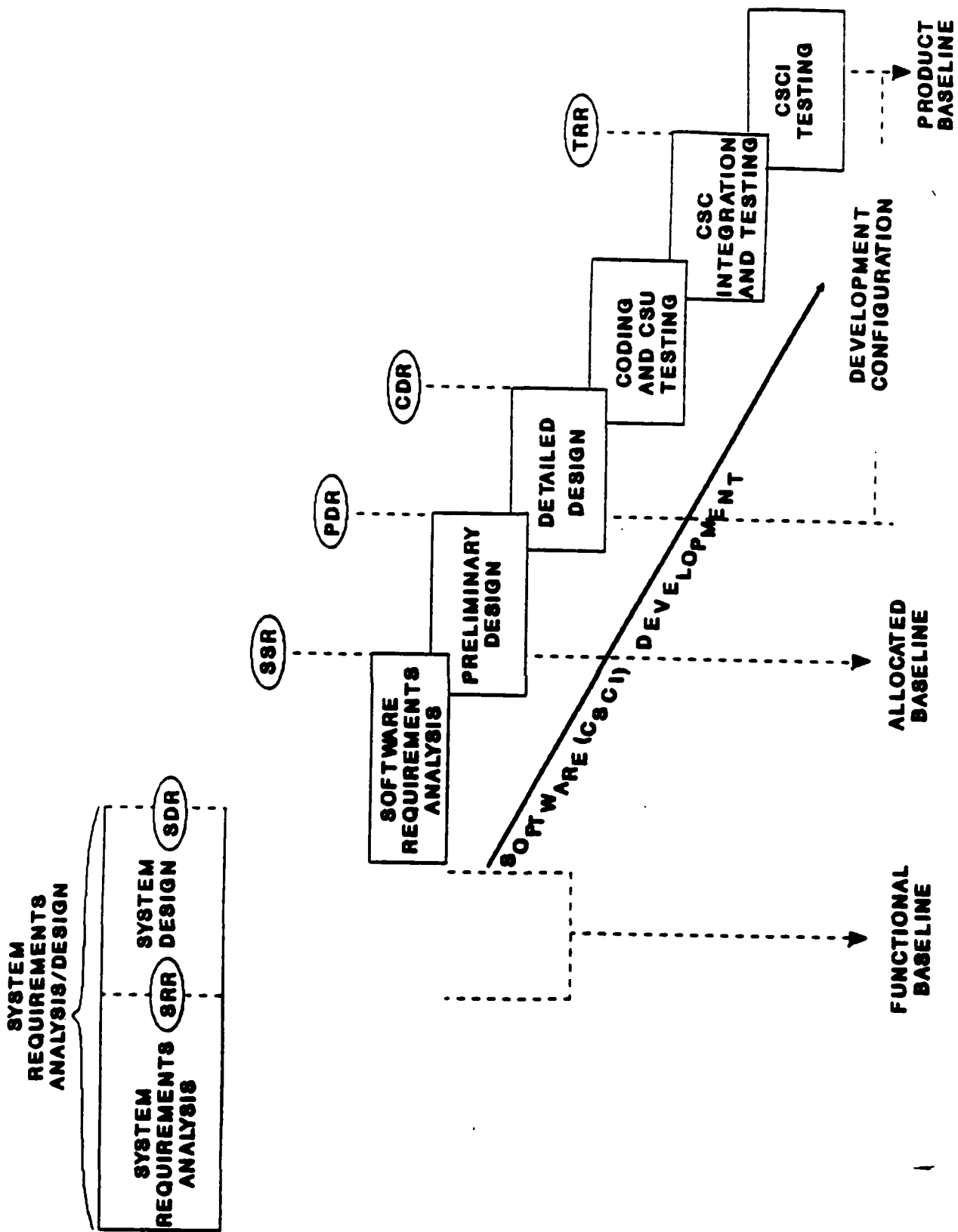


FIGURE 17 Waterfall Model

user enthusiasm for the program and will also assist in continuing the program momentum.

### Spiral Model

The spiral model, developed by Dr. Barry W. Boehm, has been successfully applied to a number of large-scale programs. Figure 18 portrays this model in its basic format.

This model is a risk-driven approach that emphasizes prototyping and incremental deliveries to allow a more realistic approach to requirements satisfaction. It provides structure to the concept of "design a little, build a little" and allows evaluation and feedback on each cycle of software development. Each spiral model cycle follows the same sequence of steps: designate objectives, alternatives and constraints; evaluate alternatives and resolve risks relative to objectives and constraints; develop the appropriate product; then review and plan the next cycle. This provides a flexible, iterative answer to the problem of inherently long delays during software development. It has the following particularly positive features:

- It fosters the development of specifications that are not necessarily uniform, exhaustive, or formal, in that it defers detailed elaboration of low-risk software elements and avoid unnecessary breakage in design until the high-risk elements of the design are stabilized.

- It incorporates prototyping as a risk-reduction option at any stage of development.

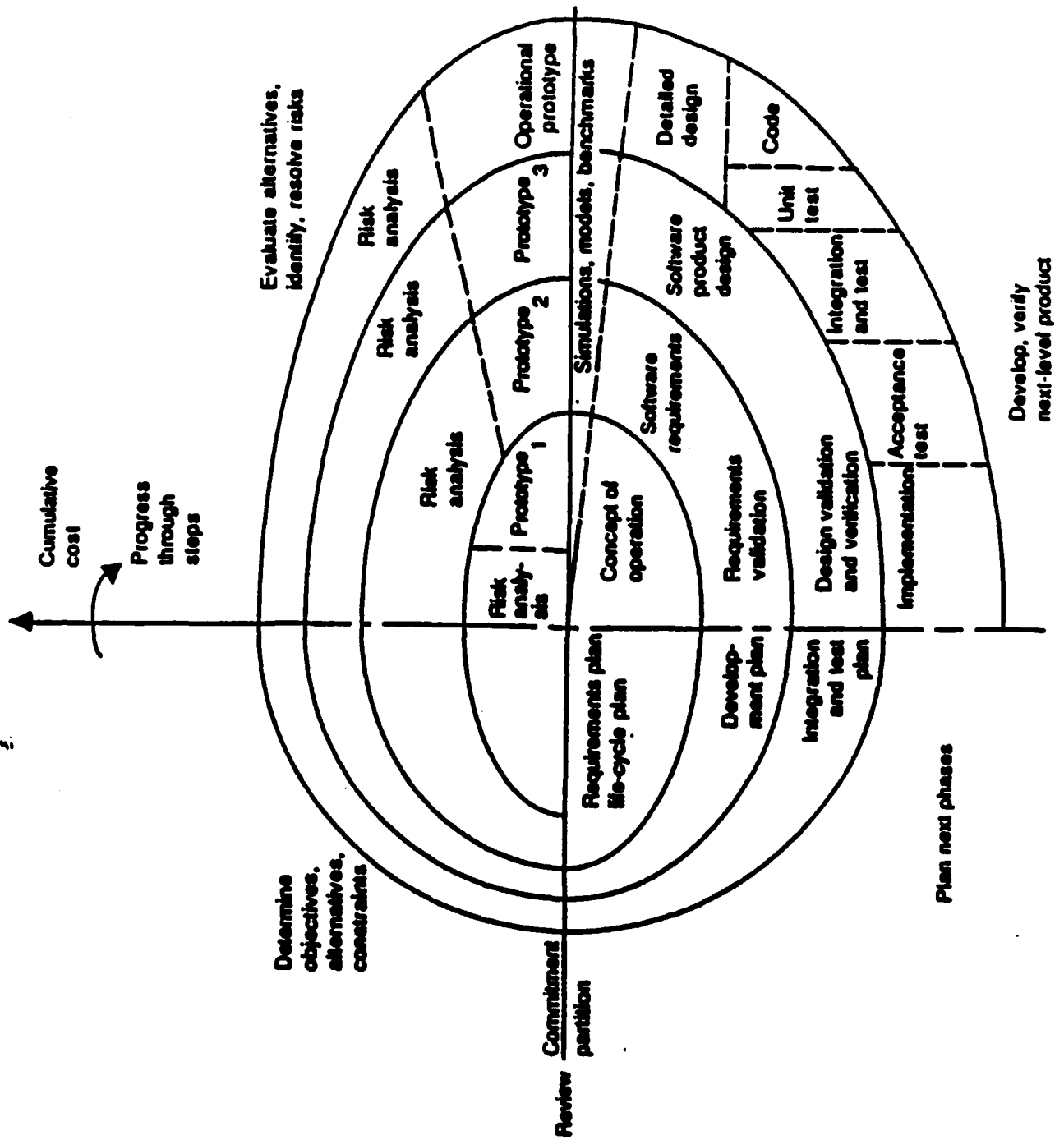


FIGURE 18 Spiral Model

-It accommodates reworks or go-backs to earlier stages as more attractive alternatives are identified or as new risk issues need resolution.

-It focuses early attention on options involving the reuse of existing software. The steps involving the identification and evaluation of alternatives encourages these options.

-It accommodates preparation for life cycle evolution, growth, and changes of the software product. The major sources of product change are included in the product's objectives.

-It provides a mechanism for incorporating software quality objectives into software product development. This mechanism derives from the emphasis on identifying all types of objectives and constraints during each round of the spiral.

-It focuses on eliminating errors and unattractive alternatives early. The risk-analysis, validation, and commitment steps cover these considerations.

-It does not involve separate approaches for software development and software enhancement.

-It provides a viable framework for integrated hardware-software system development.<sup>6</sup>

### Prototyping

The term "prototyping" is wrongly assumed by many to encompass only early software delivery. The early cycles of prototyping--which allows for better understanding of user requirements (the greatest risk in software development) and for mitigating later design risks--are either ignored or not

understood. Such an exclusive orientation to only so-called "rapid" prototyping puts user expectations on a collision course with what actually must occur with prototyping as a normal part of modern software engineering.

The various stages--demonstration through operational--of prototyping and their relationship to software development must be institutionalized in a consistent manner. The software development effort must provide a standardized approach to prototyping, its use for risk mitigation, and its relationship to the overall software life cycle.<sup>7</sup>

#### Demonstration Prototyping

This work is currently being managed in an ad hoc manner. Each site team is now prototyping different user interfaces at various levels of detail. Demonstration prototyping must be refocused in direct support of software product lines under development.

Demonstration prototyping activities must be placed under tight centralized control, must be made an integral part of the systems development process, and must be managed separately from operational prototyping. It should be used for front-end risk mitigation of user requirements and refinement of user-oriented operational concepts.

While demonstration prototyping is clearly cyclic and will still be required throughout the software life-cycle, the bulk of it supporting current software products lines must be completed as quickly as feasible; then those demonstration resources should

be redirected to supporting centralized/decentralized operational prototyping.

#### Operational Prototyping

This activity offers high returns for the program, since software can be developed and fielded early, as end-user's operational needs dictate. Therefore, the majority of available prototyping resources, both at the central design facility and at sites, should be ultimately targeted to operational prototyping. Operational prototyping should be given the strongest emphasis, managed as an integral part of the software development process, and targeted to so-called "high payoff" prototypes.

"High payoff" prototypes must satisfy an unfulfilled need, have fairly simple data needs, be reusable across sites, and ideally be workstation-based. These operational prototypes should evolve into the nucleus of a future software product line and must be derived from an appropriate functionally baselined software requirement specification.<sup>8</sup>

#### Goal #2: Build Robust, Reusable Software

Software development is the essence of the AWIS program. Special emphasis must be placed on the areas of system architecture, incremental development planning, and software and data base design.

#### AWIS System Architecture Definition

Most of the assumptions upon which the Phase I program was structured have changed. The net effect of these changes, nearly

all of which are external to the program, has been to compound overall software design risks. The program has been reacting in a piecemeal fashion to such changes without a coordinated, consistent architectural viewpoint.

Accordingly, the top Phase II/Option Year Two priority must be the definition of a pragmatic, realistic and affordable basic AWIS system architecture. A generic architecture, illustrated in Figure 19, must be developed in accord with this guidance:

- The architecture will initially be Honeywell/Bull based and must use only existing WWMCCS-certified products.

- Current "systems-high" operation will be the baseline security architecture with evolution to split "systems-high."

- The architecture must make conservative assumptions about the availability of other vendors' products and should take an "open systems" orientation.

- It will be "loosely coupled" to joint developments and defined in detail where assumed/critical linkages exist.

- Progression toward a relational database environment using the following criteria is required:

- AWIS workstations must be a key component and evolution to distributed databases operating on these workstations is desired.

- Quick migration to a relational database environment with a RDBMS accessed via an AWIS LAN with workstation must be shown.

- Management Information Systems (MIS) impacts on standard Army C2 software must be considered.

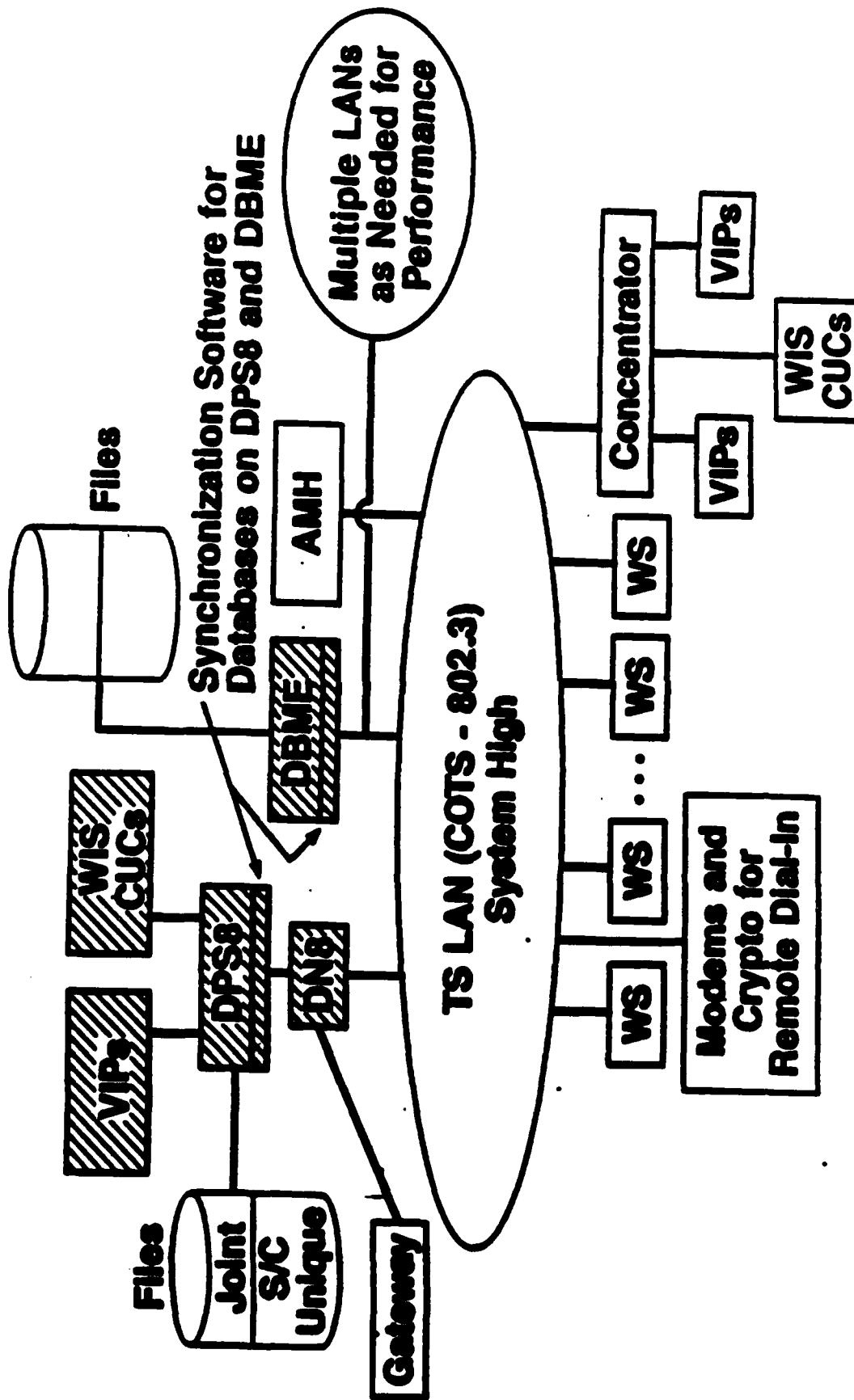


FIGURE 19 Generic Architecture



--The architecture must take cognizance of DCA's plans in the reorganization effort and integrate AWIS's various LAN and AMHS initiatives on a time-phased basis.

This architecture should be a "living" one, frequently updated and integrated into the system engineering/development process that forms the basis of all subsequent development activities.

#### Incremental Development Plan

An Incremental Development Plan (IDP) that supports the architecture is required and should be the foundation for all subsequent program activities. Current software developments must be integrated into the build sequence. The IDP must be finalized together with the AWIS systems architecture and should augment it.

The IDP should also identify opportunities for possible later involvement of site resources in the development of site software that may be required to fully field functional product lines. It must evolve the system architecture into detailed site-by-site architectures and fielding schedules.

#### Software Design

The software design assumptions upon which the program was based are not yet institutionalized in the program's current system engineering methodology. A software design philosophy should be developed with the following provisions:

-A layering philosophy as illustrated in Figure 20 that has goals of:

--Making applications programs independent from vendor-specific hardware and software.

--Isolating application programs from the data architecture.

-The use of Commercial Off-The-Shelf (COTS), modified COTS, and custom packages, at all levels to allow users, if possible, to solve their own problems via ad hoc query and minimize the need for massive application software maintenance.

-Allowing users/site personnel the flexibility to build and alter application-specific Input/Output (I/O) screen dynamically by identifying and providing the tools to do so.

-Addressing the resolution of interface conflicts and the establishment of formal software interface control procedures.

Additionally, the desired software design approach must specify how to provide the core software necessary for users to do their jobs while integrating tailorable front-ends into the design to accommodate later changes in user's functionality.

#### Data base Design

The relational environments and Ada-SQL bindings which seemed quite reasonable assumptions at the initiation of the program are not yet available. On-going data administration (WISDIM-A) activities must be better defined and integrated with software developments so that full supportable packages from a data administrator's viewpoint are fielded. Accordingly, the

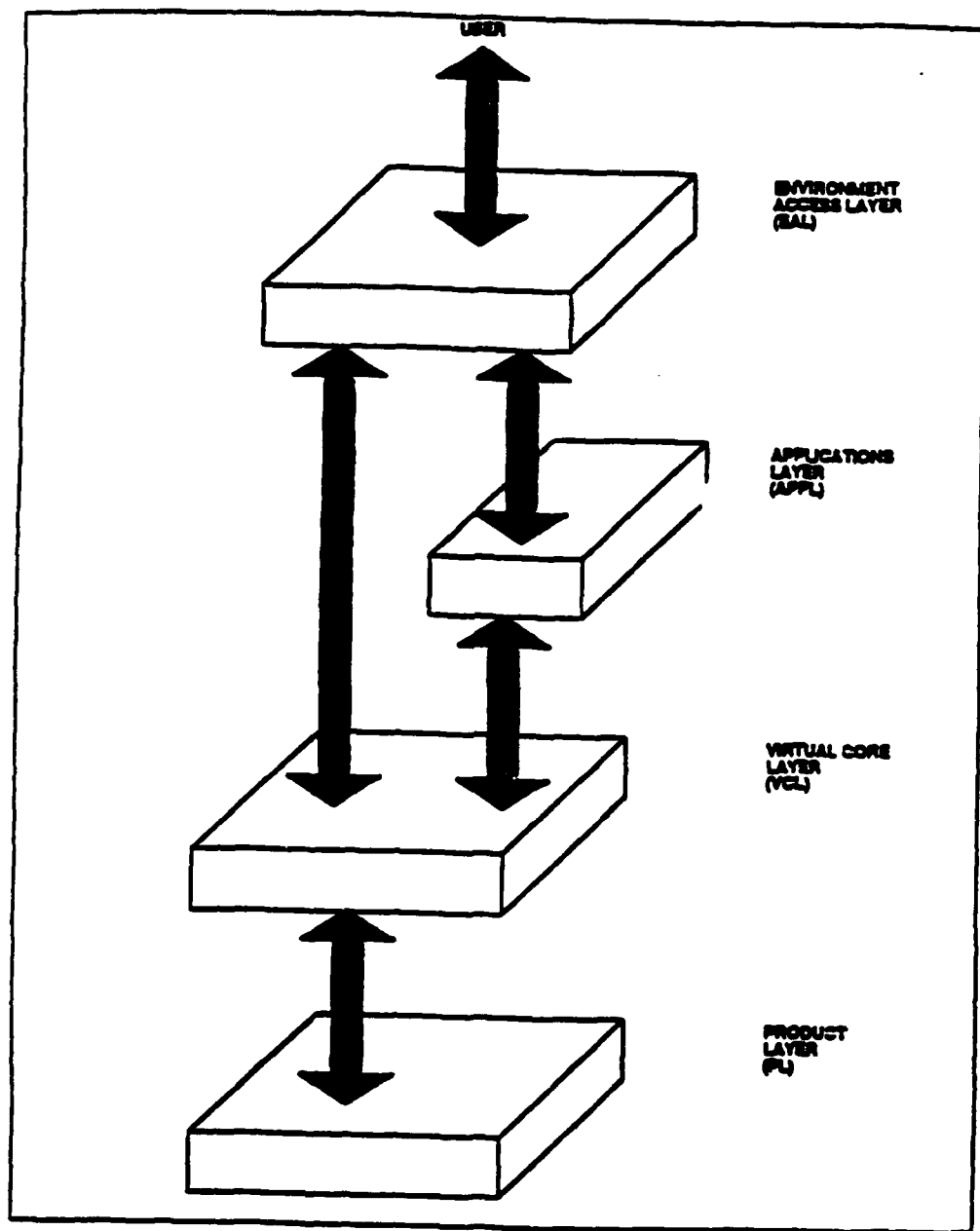


FIGURE 20 Software Layering

following data base design strategies should be followed:

-Initially, an effort must be made to design software to operate in both the hodgepodge of existing network and flat file DBMS environments currently at sites as well as a modern relational data base environment.

-Several areas of data base-oriented prototyping in accordance with the risk mitigating methodology of the spiral model must be made an integral part of the program:

--Prototyping must use the most current commercial GCOS-8 products to specify transition risks if and when those products become WWMCCS-certified.

--Fielding, development, and data base design should make no assumptions about future product availability from any vendor.

--Incremental development and prototyping of the ultimate relational data base design must be done in a RDBME prototyping central design facility.

--Distributed data base management systems should also be investigated in parallel with database design prototypes.

-A better understanding of the data needs of the various on-going non-AWIS (joint) prototypes is required. Their existence cannot be ignored and their impacts must be factored into the overall global database design.9

### Goal #3: Emphasis Fielding and Transition

Fielding and transition are the most visible, but currently the least understood, aspects of the AWIS software effort.

Fielding and transition levels of effort are frequently neglected in the current program. Left unaddressed, they may overwhelm the program.

The program has to better distinguish and control "site-specific" as opposed to "system-wide" fielding activities. Both must be aggressively managed as distinct yet mutually complementary activities.

#### Site-specific Fielding

The program must produce and field functional software that can be cost-effectively reused across many sites. Site-specific fielding plans must therefore address:

- Identification of software build orders that consider their data dependencies as well as their fielding feasibility, given an evolving user-requirements baseline and an evolving global relational database design.

- Problems inherent in trying to design and implement a modern relational database management system at a site that must continue parallel operation using a variety of obsolete network DBMSs and flat files.

- Development of expendable, site-specific transition software to field selected product lines.

- Delineation of mutual fielding and transition responsibilities between the various site support teams and site programming/maintenance staffs.

### System-wide Fielding

System-wide fielding must include closer coordination with JOPES development, synchronization with joint data base transition plans, and establishment of a TRW organization to focus on fielding and transition.

The current edition of DCA's WWMCCS ADP Modernization Plan (WAMP) cites the new role DCA will play as the government's systems integrator. Previous AWIS problems encountered while working with the now disestablished JWIS PMO are well known; they included the repeated inability to influence global design decisions that clearly impacted AWIS.

The WAMP does not explicitly take cognizance of service modernization programs nor does it address how joint and service-unique transition and fielding will be synchronized. System engineering and integration concerns appear to be limited to joint activities only. AWIS must make it a matter of top priority to establish close coordination and foster a cooperative environment with the DCA program.

TRW currently has no single organizational focal point that has fielding and transition responsibility. One must be established and should be staffed with a mix of developers, system integrators, and site-knowledgeable personnel.<sup>10</sup>

# ENDNOTES

1. Interview with George Prosnik, LTC, Product Management Office SACCS, Fairlakes, Virginia, 3 December 1989.
2. "Contract DAEA 26-87-C-0001, "Project Management Office AWIS, January 1987, p. 3.
3. Prosnik, December 1989.
4. Defense Systems Management College, Mission Critical Computer Resources Management Guide, p. 5-4.
5. Barry W. Boehm, "A Spiral Model of Software Development and Enhancement," Computer, May 1988, p. 68.
6. Boehm, p. 69.
7. Defense Systems Management College, p. 9-10.
8. Prosnik, December 1989.
9. Defense Systems Management College, Joint Logistics Commanders Guidance for the Use of an Evolutionary Acquisition (EA) Strategy in Acquiring Command and Control (C2) Systems, pp. 9-12.
10. Interview with James Bray, Project Management Office AWIS, Fort Belvoir, Virginia, 10 November 1989.

## CHAPTER IV

### CONCLUSIONS AND RECOMMENDATIONS

Through the modernization of strategic communications and ADP hardware and software, AWIS will provide commanders with a modernized, reliable, operationally enhanced capability. Commanders will be able to rapidly determine unit availability and readiness and assess force sustainment capabilities and shortfalls. AWIS will provide real-time information in a secure environment with the NCA, CinCs, services and other agencies; it will allow the manipulation of critical information to support the unique needs of decision makers. In addition, AWIS will provide the capability to track the status of troop mobilization and deployment from home station to theater and exercise command and control of critical resources throughout the mobilization and deployment process.

### CONCLUSIONS

AWIS is a high leverage program that is delivering critical hardware and software products to major Army commanders and CinCs to satisfy their documented requirements. The C2 void at EAC is being filled with products from both the Army Command and Control System (ACCS) program and AWIS. The integration of hardware and software, not now existing in many functional areas, will permit resource based planning and execution that will provide synergism and enhance combat power. Standardization will lower life cycle costs and improve the Army's war fighting ability by reducing the



learning curve for use of automated systems in major command centers and at EAC.

#### Hardware

The original AWIS program was largely software oriented. With the present reestablishment of the Joint WIS program office, the question of hardware development has significantly increased in importance. The AWIS program must, in the interim, develop required hardware in order to continue to provide enhanced C2 capabilities to the Army. Without a viable development plan, hardware could become the weak link in the overall AWIS program chain.

#### Software

The overall thrust of the software development recommendations calls for for a rapid move by AWIS to an "open systems" distributed relational data base architecture, a greater emphasis on user-oriented applications, a heavier reliance on prototyping as the primary vehicle to mitigate risk and validate user requirements, targeting of early delivery operational prototypes, more frequent and incremental product deliveries, and a stronger commitment to fielding and transition.

### RECOMMENDATIONS

The AWIS program concerns and goals outlined in this study as well as related recommendations and implementation strategies

are realistic, sound and relevant to the overall program. Recommend that these goals, general policies and strategies be used as the basis for further detailed program planning and execution.

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3. Boehm, Barry W. "A Spiral Model of Software Development and Enhancement." Computer, Vol. 34, May 1988, pp. 65-70.
4. Bray, James. Project Management Office AWIS. Personal Interview. Fort Belvoir, Virginia: 10 November 1989.
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6. Defense Systems Management College. Joint Logistics Commanders Guidance for the Use of an Evolutionary Acquisition (EA) Strategy in Acquiring Command and Control (C2) Systems. Fort Belvoir, Virginia: March 1987.
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